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Household survey and waste characterisation for Nukuhetulu, Tonga

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Abbreviations

IWP	International Waters Project
kg	kilogram
NPDT	Nukuhetulu Project Development Team
POP	persistent organic pollutants
SPREP	Secretariat of the Pacific Regional Environment Programme
TOP	Tongan pa'anga
WHO	World Health Organization

Executive summary

The household survey and waste characterisation study collected baseline information that assisted the process of identifying pilot activities for the International Waters Project (IWP)-Tonga in Nukuhetulu.

Relevant data and information at the village level in Tonga is sparse, old or incomplete. This report is an attempt to address this information gap

Basic household information included information such as the number of people per household, gender of household members, levels of education and income, sources of income and employment status, sources of energy, access to freshwater, type of housing and latrines, household assets, household health, land entitlement, village committees, priority community issues to be addressed by IWP, waste management practices, solid waste characterization, and sewage management.

This study included a face-to-face questionnaire, a calculation of the weight of different types of solid waste, and an estimation of sewage outputs per household over a seven-day period. The socio-economic characteristics of the community were typical of many small rural communities: large numbers of people in a household, generally low income level supplemented with a high level of remittances, high self-employment figures, and generally low to medium education levels.

This waste characterisation study, however, revealed that the amount of solid waste and sewage generated per household (and per person) is fairly high compared with other studies conducted in the capital of Tonga. The most common method of waste disposal is burning waste, and taking waste to a family's bush allotment, were it is buried or burned.

The community of Nukuhetulu identified three priority issues to be addressed by IWP:

- Improve toilets and eliminate pit toilets
- Improve access to freshwater
- Improve water management conditions through the water committee.

1 Introduction

Tonga's International Waters Project (IWP) designed a pilot project that included the active participation of the people of Nukuhetulu as well as other stakeholders. The pilot project aimed to address the current priority environmental concern for Tonga, which is the "degradation of marine and freshwater quality". Pilot activities focused on community-based waste reduction, and were supplemented by the improvement of fresh water quality. However, to identify relevant and appropriate community-based activities that could be supported by the IWP and to be sustained by Nukuhetulu when the IWP ended, several baseline studies were carried out.

A community awareness, engagement and participatory workshop was held at Nukuhetulu village (8–10 September 2003) as part of initial activities during the design process (Fakaosi and Kara 2004). Because existing information is outdated and incomplete, and because there is a lack of information and data on waste types and quantity for this community, the workshop identified the need to collect baseline information for Nukuhetulu. The baseline information collected was instrumental for the pilot project design as well for monitoring activities. Socioeconomics and waste characterisation were the two main areas that required more data.

1.1 Survey objectives

1.1.1 Socioeconomic survey

The initial profile of Nukuhetulu was based on outdated and incomplete data, including the 1996 Census Report where the reporting format was based on the main islands (Tongatapu, Vava'u, and Ha'apai), rather than by village. Specific information to be collected from Nukuhetulu village included:

- population/demographics (based on the household unit): head of household, size of household, gender of household members, sources of income, and education level;
- services and infrastructure: access to fresh water, sources of energy, water and health standards;
- social structure: traditional social structure, churches and village committees; and
- land ownership.

1.1.2 Waste characterisation study

General and specific information on waste that contributes to the degradation of coastal and marine water quality in Nukuhetulu was lacking. Therefore, a waste characterisation study was needed to provide the information required for the development of relevant community-based activities to address waste issues.

The waste characterisation study examined:

- sources and generators of waste;
- quantities and composition of waste;
- domestic animals;
- current waste management practices (e.g. recycling, reduction, and disposal); and
- future options for waste minimisation programmes in Nukuhetulu.

These issues were identified in the participatory problem analysis workshop in 2003, and the waste characterisation survey aimed to investigate these issues further.

2 Methodology

2.1 Survey preparation

The Nukuhetulu Project Development Team (NPDT) developed survey objectives. A survey methodology and questionnaire (Annex 1) was then developed for further discussion and input from NPDT before finalisation. The questionnaire was a combination of open-ended and closed questions. Open-ended questions allowed respondents to give an opinion on any of the questions asked. Respondents' responses were "reconfirmed" by the interviewer through observations. Closed questions on the other hand were used to illicit exact answers to questions such age, sex, type of latrine in use, etc.

A briefing workshop was held for all households in Nukuhetulu to: 1) ensure public awareness of the survey; 2) discuss survey objectives, nature of questions, and expected survey duration; and 3) enlist assistance from the community during the survey period (including what to expect from the community and the role of the survey team). A follow-up survey preparatory meeting was conducted to familiarise the survey assistance team on methodology, questions, and what to expect during the survey.

The socioeconomic household survey and the waste characterisation survey were combined and carried out at the same time over a period of seven days, from the 1–8 December 2003. A locally trained survey team (Annex 2) was selected to assist in conducting of the survey. Each team consisted of two members from the NPDT and one from the Nukuhetulu community.

The community of Nukuhetulu was divided into eight blocks and each household was numbered (Annex 2). Each survey team was allocated to a certain block and was responsible for both the socioeconomic and waste characterisation components of the survey.

Survey equipment was provided, including weighing scales, empty bags, gloves, tarpaulin, survey papers, writing boards, and paper and pens.

2.1.1 The Survey

The survey was a combined qualitative and quantitative data collection. It was carried out in the Tongan language. Face-to-face interviews and on-site weighing of waste by the survey team were the survey methods adopted. All answers and observations by the survey team were recorded immediately on the survey questionnaires.

Most of the qualitative data collected was from the waste characterisation component of the survey, generated through an on-site weighing of waste generated by each household. Each household was given empty 25-kg bags for waste collection, and instructions for classifying the waste for each (seven) day surveyed.

All waste collected was emptied onto a tarpaulin sheet and weighed and recorded after confirming the type of waste (according to the classification table provided in the questionnaire).

2.1.2 Response rate

All households in Nukuhetulu were surveyed, giving a response rate of 100%.

2.1.3 Data management and analysis

The data collected were entered and stored in an MS Excel spreadsheet for analysis and interpretation. A basic statistical programme (used with MS Excel) was used for data analysis. Percentages (both in the socioeconomic survey and waste quantities generated), were also calculated.

3 Results

3.1 Socioeconomic household survey

This section provides the main findings of the IWP household survey in Nukuhetulu.

3.1.1 Number of households in Nukuhetulu

The 2003 IWP survey recorded 64 households in Nukuhetulu. The 1996 census recorded 57 households, reflecting a 12% increase in Nukuhetulu household numbers in seven years.

3.1.2 Nukuhetulu population and gender

The 2003 IWP survey counted 391 people in Nukuhetulu, of which 200 (51%) were males and 191 (49%) were females. This is a slight variation in the male to female ratio recorded in the 1996 census, which recorded 365 people in Nukuhetulu, of which 174 (48%) were males and 191 (52%) were females.

The total population of Nukuhetulu has increased by 7% percent in seven years, representing an annual population increase of 1%. The annual growth rate of Tonga in 1996 was 0.3%, whereas in Tongatapu it was 0.5% (Government of Tonga 1996).

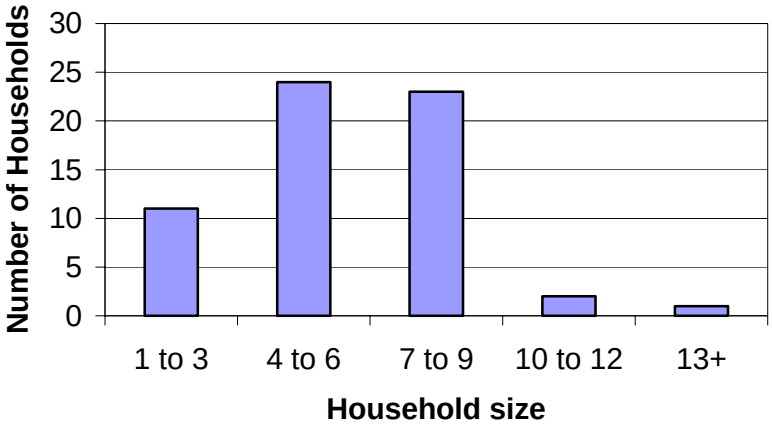
Of the 64 households in Nukuhetulu, eight (13%) were headed by females. This illustrates that Tonga is a patrilineal society, where males head the majority of the households (i.e. 56 households or 87% in Nukuhetulu). This is consistent with the 1996 census which recorded that males headed 81% of all households in Tonga.

3.1.3 Household structure

The household structure of Nukuhetulu shows the relationship of household members to the head of the household. Tongans headed all households in Nukuhetulu. Out of the total households surveyed, 52% consisted of nuclear families (head with or without spouse and children), 1.4% were made up of parents with no children, and 32% were extended family households.

The average household size in Nukuhetulu was 6.2. Figure 1 indicates that 24 households (38%) in Nukuhetulu had household sizes of 4–6 people.

Figure 1: Nukuhetulu Household Size, 2003



3.1.4 Age groups

The age distribution indicated that 16% of the Nukuhetulu population was under 5 years of age, and 2.8% were aged 70 years or over (Table 1). More than half (or 55%) of the population was aged 24 or less, indicating that Nukuhetulu has an "intermediate population".[1] The population aged 25–69 made up 41% of the total population of Nukuhetulu.

3.1.5 Education level

Primary education in Tonga for ages 6–14 is compulsory, and this is reflected in the fairly high percentage of school-age children (5–19 years old) who were in primary school (53%); 23% were in secondary school and 24% were not at school.

About 3% of the total population of Nukuhetulu had some technical training and university qualifications, while 30% had attended high school but left school without any formal qualifications.

Table 2 shows the number of people in each education level. It also shows that the majority of households (48) had members or a member that did not complete school at the secondary level.

Table 1: Nukuhetulu population distribution by age and sex

Age*	Gender		Total
	Male	Female	
All ages	200	191	391
0–4	24	37	61
5–9	28	32	60
10–14	18	10	28
15–19	19	18	36
20–24	16	14	30
25–29	17	15	32
30–34	17	13	30
35–39	14	10	24
40–44	8	8	16
45–49	2	6	8
50–54	3	5	8
55–59	7	11	18
60–64	4	6	10
65–69	8	5	13
70–74	3	2	5
75+	4	2	6

* The age of six interviewees was not recorded

[1] The median age is the age that divides the whole population into two equal sizes, with one half younger and the other half older than the median age. Populations with medians under 20 may be described as a "young population", those with medians between 20 and 29 may be described as an "intermediate population", and those with medians of 30 or more as an "old population".

Table 2: Education levels of households members

Level of education	Number of people	Number of households with members in each education level
No education	4	3
Left school at primary level	47	24
Left school at secondary level	116	48
Completed secondary school with relevant certificates	22	16
Diploma or technical training	7	7
University training with degrees/diplomas	3	3

3.1.6 Sources and level of income

Of those considered to be of working age (20–64 years), 31% were employed and 23% were self-employed (including semi-subsistence and self employment, such as farming and fishing), and 46% were subsistence only.

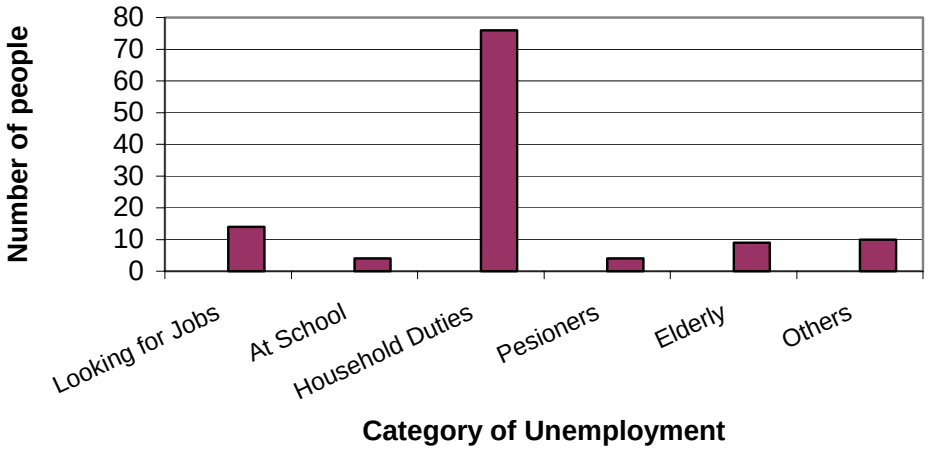
Figure 2 shows the level of unemployment in Nukuhetulu. About 19% of the total population of Nukuhetulu was engaged in home duties, while 4% were looking for jobs, with the remaining still at school, elderly people on pensions, or others.

Table 3 shows the number of people employed and the type of employment that the population of Nukuhetulu was engaged in. Over half of those who were employed (60 %) were self employed in various categories, as shown in Table 3.

Table 3: Number of people employed, by activity

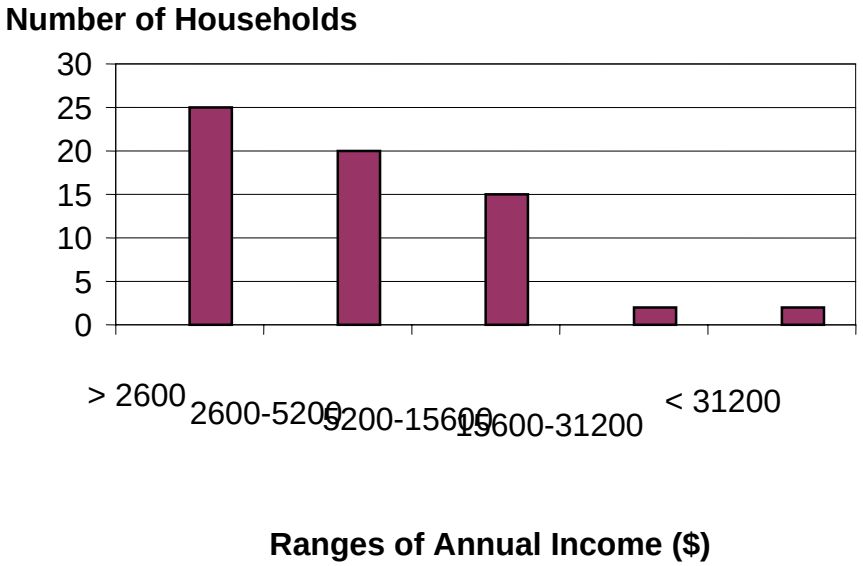
Activity	Number
self employed	
subsistence farming	45
semi cash farming	22
subsistence fishing	13
semi cash fishing	8
domesticated/subsistence animal farming	15
domesticated/cash animal farming	14
subsistence tapa/mat making	25
cash tapa/mat making	5
carving	1
others	2
employed by others	
church	3
private sector	26
government	15

Figure 2: Number and Category of Unemployment, 2003



Over 70% of the total households were found to be in the low-income level brackets (see Fig. 3) (i.e. less than 2,600 Tongan pa'anga [TOP] annual income, or between TOP 2,600 and 5,200); 45 households (24%) were in the mid-level income brackets (between TOP 5,200 and 15, 600 annually). Only 6% were in the upper income level (from TOP15,600 and 31,200 and over). However, more than 60% of the total households received some remittances throughout the year from family members and relatives living overseas or in other parts of Tonga.

Figure 3: Level of Annual Income (TOP) by Household



3.1.7 Sources of water

Out of the 64 households in Nukuhetulu, 31 (49%) had access to the village water supply (piped) and 30 (48%) had access to the village water supply system and owned a water tank as well; about (3%) of all households obtained their water from elsewhere.

3.1.8 Source of energy for lighting and cooking

The main source of energy for lighting was electricity. About 84% of all households used electricity for lighting while 19% still use kerosene.

About 45 households used firewood as their main source of energy for cooking. Thirty-four households used LP gas for cooking, six households use electricity, and only nine households relied on kerosene (see Table 4).

Table 4: Number of Households by Sources of Energy for Lighting and Cooking

Source of energy for lighting	Number of households	Source of energy for cooking	Number of households
Electricity	54	Electrical appliance	6
Kerosene	12	Gas	34
Others	0	Kerosene	9
		Firewood	45
		Others	0

3.1.9 Type of buildings

The 2003 IWP survey showed that out of the 63 households in Nukuhetulu, 52 (83%) lived in European-style houses made of wood, and 5 (8%) lived in brick or cement houses. About 6% of all households lived in hard cardboard houses and 5% lived in iron corrugated houses.

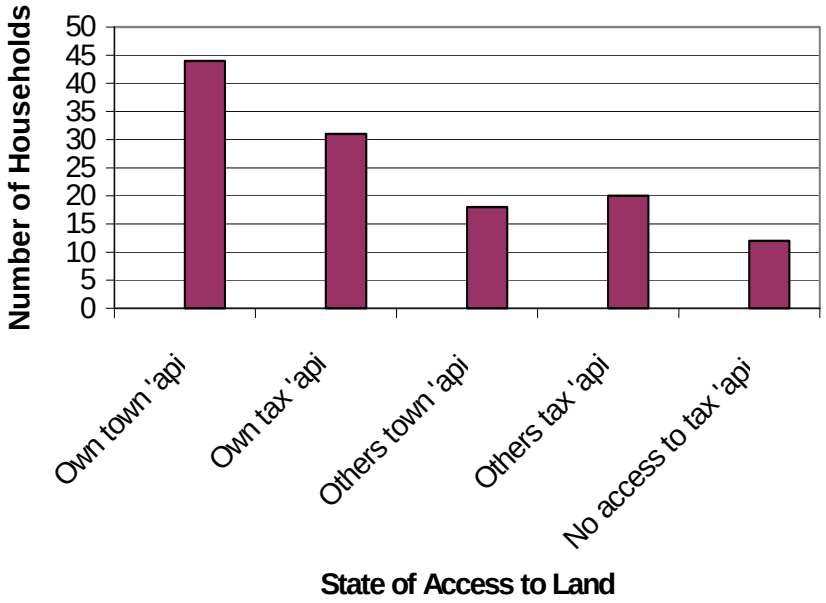
3.1.10. Land tenure

Figure 4 shows that 44 households (70 %) out of the total households in Nukuhetulu lived in their own registered town allotments, and 31 households (49 %) had registered tax allotments where they planted crops. There were 18 (29 %) and 20 (32 %) households who lived and farmed relatives' town and tax allotments respectively, while 12 households (19 %) did not have access to any tax allotment for farming; one household was occupying a church registered town allotment as he is employed by the church.

3.1. 11 Household assets (vehicle, boat only)

Forty-three per cent of all households (27) in Nukuhetulu owned one or two vehicles, while 21% (13 households) owned an outboard motor (boat).

Figure 4: Land Titlement and Access by Household, 2003



3.1.12 Religion

The Free Wesleyan Church of Tonga and the Free Church of Tonga had the largest congregations in Nukuhetulu, with 22 households (35 %) each as members, followed by the Mormon Church (14%) and the Tokai Kolo Church (8%) (see Table 5).

Table 5: Religious Denomination by Household

Religious denomination	Number of households
Free Wesleyan Church	22
Free Church of Tonga	22
Mormon Church	9
Tokai Kolo	5
Catholic Church	2
Church of Tonga	1
Jehovah Witness	1
Seven Days Adventist	1

3.1.13 Residence time in Nukuhetulu

Of the total households in Nukuhetulu, 79% had lived in Nukuhetulu for more than 16 years. However, 13% had recently moved to Nukuhetulu (in the past five years), while 8% had lived in Nukhetulu for 6–15 years.

3.1.14 Village committees

More women than men were involved in village committees, with 22 households having women who were members of the Village Women Development Committee. The Youth Committee was the second largest village committee with 13 households that had youths involved in this committee, followed by the Village Water Committee with only 6 households.

Other committees — predominantly church and sports committees — had members from Nukuhetulu.

3.1.15 Health

Some significant health issues were listed by very few households (one household for each disease) including asthma, diabetes and cancer. However, dengue fever was recorded in 4 households and diarrhoea in 17 households.

3.1.16 Main environmental issues/problems in Nukuhetulu

The two main environmental issues identified during the survey were free ranging pigs (main issue for 44 households), and littering and increasing rubbish (main issue for 43 households). Table 6 lists others issues identified by households.

3.1.17 Importance of waste management

Over 90% of all households in Nukuhetulu claimed that waste management was *very important* to them, while 6% said that it was *important* and only 2% said that it was *not important*. The importance of waste to the people of Nukuheulu rests on its relevance to residents' health and the aesthetic value for the village.

3.1.18 Nukuhetulu: IWP priorities

More than 50% of all households in Nukuhetulu chose the priority issues listed in Table 7 as the ones to be addressed by IWP.

Table 6: Main environmental issue by household

Environmental issues	Number of households
Free range pigs	44
Littering and increasing rubbish	43
Dumping of rubbish into the sea or coastal areas	13
Mangroves destruction	9
Poor water quality and mismanagement	9
Decreasing/loss of marine resources	8
Deforestation	8
Abundance of pit toilet	6
Soil erosion/coastal erosion	4
Burning of rubbish	2
Need for rubbish bins	2
Lack of community awareness	2
No rubbish dump	1
Vacant home that are neglected	1
Too many dogs	1

Table 7: Community Priorities to be addressed by IWP

Priority Issues	Number of households
Improve toilet from pit toilet	48
Improve access to fresh water	46
Improve water management condition through the water committee	46
Solid waste mismanagement	40
Scavenging pigs	40

Decreasing/loss of marine resources	38
Improve community awareness of environmental issues	38
Whatever the project decides to do	30
Conserve mangroves and other important trees	28
None	20

3.2 Waste characterisation survey

3.2.1 Waste composition

Table 8 shows the different types of solid waste generated. Organic waste was by far the major component (more than 92%) of the solid waste generated in Nukuhetulu.

Garden waste made up more than 52% of all organic waste (Table 9), and was followed by kitchen waste (30%).

Table 8: Percentage of waste produced by type in Nukuhetulu

Waste type	Percentage
Plastics	02.12
Glass	00.68
Metal	02.13
Organic	92.15
Textile	00.43
Construction	00.06
Potentially hazardous	00.26
Other types	02.22

Table 9: Organic waste type in percentage

Organic Waste	Percentage
Kitchen	30.37
Garden	52.14
Animal Waste	03.37
Soil	01.39
Paper	03.40

3.2.2 Waste generation

The total quantity of waste being generated in Nukuhetulu daily is approximately half a tonne (502.4 kg), which equals 183 tonnes annually. The generation rate was calculated to be 1.29 kg of waste produced per person per day.

3.2.3 Latrine type

The main toilet type used in Nukuhetulu is the flush/septic toilet (used by 52% of all households). Pit latrine toilet use is significant (33%); water pit accounted for 8% and “others” for 7%. About 63 households were surveyed.

3.2.4 Wastewater drainage

The majority of Nukuhetulu households drained their waste water from the bathroom, kitchen and washing straight into the open ground. Very few households had drainage connected to the septic tank and soakage pit (Table 10).

Table 10: Waste water drainage type at Nukuhetulu

	Bathroom	Kitchen	Washing
Septic	27	11	2
Open ground	51	76	88
Soaked pit	22	13	10

3.2.5 Septic life

Twenty households (40%) empty their septic tanks once every five years, 10 households empty theirs once in 10 years, and 11 households only empty their septic tanks once in more than 10 years.

3.2.6 Wastewater and scum calculation

Average water consumption per capita = 80 litres/day

Average domestic wastewater = 60 liters/day/capita

Average scum generated = 55 litres per day/person

Septic tank volume = 3530 litres

Wastewater

60 litres per person × total population of Nukuhetulu (388) = 23,280 litres of wastewater produced per day in Nukuhetulu

Scum

55 litres per person × 388 = 21340 litres of scum produced per day in Nukuhetulu

3.2.7 Solid waste disposal

Of 63 households in Nukuhetulu, 63% disposed of their waste by burning. About 20% disposed of their waste by throwing into the lagoon or the bush, and 16% buried their waste. Only 1% was recorded as recycling or reusing waste.

3.2.8 Chemical ue

Over 30% of all households use chemicals such as pesticides and herbicides. About 24% of households have used chemicals for only the last five years and 7% have used chemicals for over 10 years.

3.2.9 Domestic animals

Pigs and chickens are the primary domestic animals. There are 606 pigs and 553 chickens in Nukuhetulu. Eight-six dogs were recorded.

4 Discussion

4.1 Socioeconomic isues

The socioeconomic information recorded here could be used as a reliable baseline for planning and monitoring purposes in the IWP. Similarly, the waste characterization survey reflects the types and quantity of waste generated at the time of the survey. Such information should also be useful in monitoring to see whether there has been any impact of the project in terms of reducing waste produced or waste management have been improved.

In order to ensure the sustainability of the IWP pilot activities in Nukuhetulu, the following

prevailing socioeconomic conditions in the village must be considered:

- **The fairly low level of education.** IWP activities should include appropriate awareness and education aspects, to ensure the target audience is being reached using an appropriate medium(s).
- **The generally low level of income and high dependence on remittances.** Activities should be considered that encourage self-reliance among households. Activities such as home gardening can reduce the use of agricultural chemicals, and at the same time provide a more nutritious diet for families.
- **The large number of women that are engaged in home duties.**
- **Potential for partnerships.** The high median age groups (15–34 years old) and high number of youths (32%) provides the potential for partnership in implementation of project activities.

4.2 Waste characterization

Waste composition

The type of wastes generated in Nukuhetulu reflect findings by two previous studies, carried out by the World Health Organization (WHO) in 1996, and Sinclair Knight Mertz in 1999 (see Sinclair 2000). Although the waste composition is almost the same, the respective proportions of each waste type are different.

The quantities of organic waste relative to other waste types in this survey is fairly high, and this is probably attributable to the fact that a significant amount of kitchen and garden wastes were not taken to the landfill site (as compared to the results from the WHO 1996 and Sinclair Knight Metrz 1999 studies). The results presented here are an accurate indication of the quantity of biodegradable or organic wastes generated, as every households in Nukuhetulu was asked to collect all wastes generated each day.

Other waste quantities — such as aluminium and tin cans, paper and plastic wastes — are very low, due mainly to social and economic factors. Few people in Nukuhetulu consume imported packaged food and drinks compared to people from Nuku'alofa. Similarly, diapers and disposable nappies are not commonly used in the village.

Animal waste is significantly high in comparison to other wastes, and this is mainly due to high number of domestic animals (such as pigs and dogs) in Nukuhetulu.

There is very little construction waste in Nukuhetulu, implying that little construction activity took place at the time of the survey.

There is an insignificant level of hazardous waste collected from households. However, there are a significant number of farmers who used chemical for agricultural purposes (32% of households).

The implication of the survey results for IWP is clear. There is a fair amount of organic rubbish that is disposed of by each household into the environment, including the lagoon and mangrove areas. This is a typical waste management problem shared by most communities, which threatens fish and the lagoon ecosystem. In addition, certain types of waste can pose further threats and should be addressed by the IWP pilot project. Consideration should be given to addressing latrines and septic systems, animal management issues, and agricultural chemicals.

Waste quantity/generation rate

The half a tonne of waste generated each day in Nukuhetulu is high and almost twice the

quantity indicated by two previous studies conducted at the landfill site (in 1996 and 1999); generation rates are 1.29 kg/person/day (this study), 0.5 kg/person/day (WHO 1996) and 0.8 kg /person/day (Sinclair 2000).

Some difference may be due to the length of each survey (WHO study measure waste generation for 5 days; both the Sinclair study and this survey were conducted for 7 days). The difference is most likely due to the high quantity of biodegradable garden and kitchen waste, however, much of which would not have been recorded by the earlier landfill-based studies (the waste would have been disposed of through burning, burying, composting, etc.).

Sanitation

Toilet type

The high percentage of pit latrine toilets in Nukuhetulu is significant, and may be linked to social and economic issues (some households could not afford a septic/flush toilet). Affordability is a key issue, as many households have a low cash income.

It is also important to note that the high number of pit latrine toilets used at Nukuhetulu may contribute to pollution of groundwater. Previous water quality studies of the Fanga'uta lagoon and groundwater of surrounding villages have indicated the presence of *E coli* in the water. The high number of diarrhoea cases reported (by 17 households) during the socioeconomic survey may be directly linked to pit toilet use.

Drainage facilities

Almost all households in Nukuhetulu drain their wastewater directly to the ground; the absorption rate varies depending on the soil porosity (soil porosity at Nukuhetulu is generally high). It is possible that pollutants from wastewater are polluting groundwater in the area.

Domestic animals

Animal waste contributes 3% of the total organic waste. The number of domestic animals in Nukuhetulu is high (especially pigs and dogs). Domestic animal waste is considered a problem, both in terms of village aesthetics, and as a possible source of pollution groundwater pollution.

Solid waste disposal type

The majority of households in Nukuhetulu disposed of their waste by burning, although it creates further environmental problems. Persistent organic pollutants (POPs) such as dioxin and furan are formed by incomplete combustion and burning of plastics; burning also produces methane, carbon monoxide and carbon dioxide. Recycling is not a common practice in Nukuhetulu, and households are probably unaware of recycling methods.

The dumping of waste into the mangrove areas and the lagoon is a critical issue. Pollution source surveys have suggested that pollutants from land (either point or non-point source) are impacting the lagoon water quality.

Chemical use

A high proportion of the farmers in Nukuhetulu used pesticides for farming. Pesticide application can pollute and contaminate groundwater.

Septic life

A number of households at Nukuhetulu pumped the accumulated solids from their septic tanks every 5 years. Recent studies have suggested that accumulated solids should be pumped from septic tanks at intervals of 2 to 4 years.

5 Survey conclusions and recommendations

5.1 Conclusions

5.1.1 Household socio-economic survey

The results obtained from the Nukuhetulu socioeconomic survey have established useful baseline information for the purposes of the IWP.

While all households of Nukuhetulu responded that solid waste management was the most important environmental issue, the issue's importance is not reflected in the amount of waste generated and the waste management practices.

The three most important environmental issues that the community to Nukuhetulu would like the IWP to address before it ends in 2006 were:

- Improve toilets and eliminate pit toilets
- Improve access to fresh water
- Improve water management condition of the water committee

5.1.2. Summary of the waste characterization study conclusion:

- The quantities of solid waste generated in Nukuhetulu and measured by this study were higher than found by previous studies, and is higher than has been found for Nuku'alofa.
- The 90% consist of organic waste in Nukuhetulu suggested that special attention should be given to a household organic waste minimisation and reduction program.
- A high number of households still use pit latrine toilets, which is a concern with regards to possible pollution of groundwater.
- Groundwater may also be contaminated by untreated wastewater draining from point sources.
- Burning is a commonly used method of disposing of waste.
- Awareness programs are needed for the Nukuhetulu community regarding how their activities contribute to waste-related problems.

5.2. Recommendations

Waste minimization and reduction program for Nukuhetulu

Waste	**Type**	**Options**
Solid waste	1. Garden and food waste	*Reduce through:*
		Composting
		Mulching/shredding
		Mix-waste composting
		Reuse (feeding domestic animals)
		Programme options:
		Community education program on sorting and proper waste disposal
		Training/workshop on waste management
		Develop a community-based waste reduction action

Waste	Type	Options
		plan
	2. Paper and cardboard	*Reduce through:*
		Reuse and processing
		Eco-packaging
		Composting
		Recycling
		Education
	3. Household hazardous waste:	Take back policy (village should approach the government recommending hazardous waste to take back to the manufacturer)
		Collection and dumping at the allocated site at new dumpsite
		Education.
	4. Plastic	Recycling
		Reuse
		Shopping bags
		Education
	5. Soil/rubble	Process as a garden mixer or fill material
	6. Construction and ceramics	Processing and crushing for mixer and fill
	7. Metal	Recycling
Liquid waste	1. Toilet type	Encourage the use of septic toilet or get rid of pit latrines?
	2. Drainage system	Encourage drainage system to septic
	3. Domestic animals	Decrease numbers of dogs, etc
		Fenced pigs
	4. Chemicals	Promote organic farming practices
		Educational program
	5. Septic sizes	Recommend STD size
		Guidelines for septic size (WHO)

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Annex 1: Survey Team

Group Number	Survey Team Member	Local Counterpart
1.	Dr. Netatua Precott	Ane Talasing
2.	Lesieli Niu	Tevita Tui Ika
3.	‘Ofiu ‘Isama’u	‘Ana Lautal
4.	‘Asipeli Palaki	Kelenitesi Ika
5.	Semisi Tongia	‘Ofa Matafahi
6.	Sione Faka’osi	Limi Hai Fakahau
7.	Sioape Tu’iono	‘Alipeti Olevao
8.	Takapuna Ika	Milate Pau’uvale

Annex 2: Nukuhetulu households

(See household map with survey numbers)

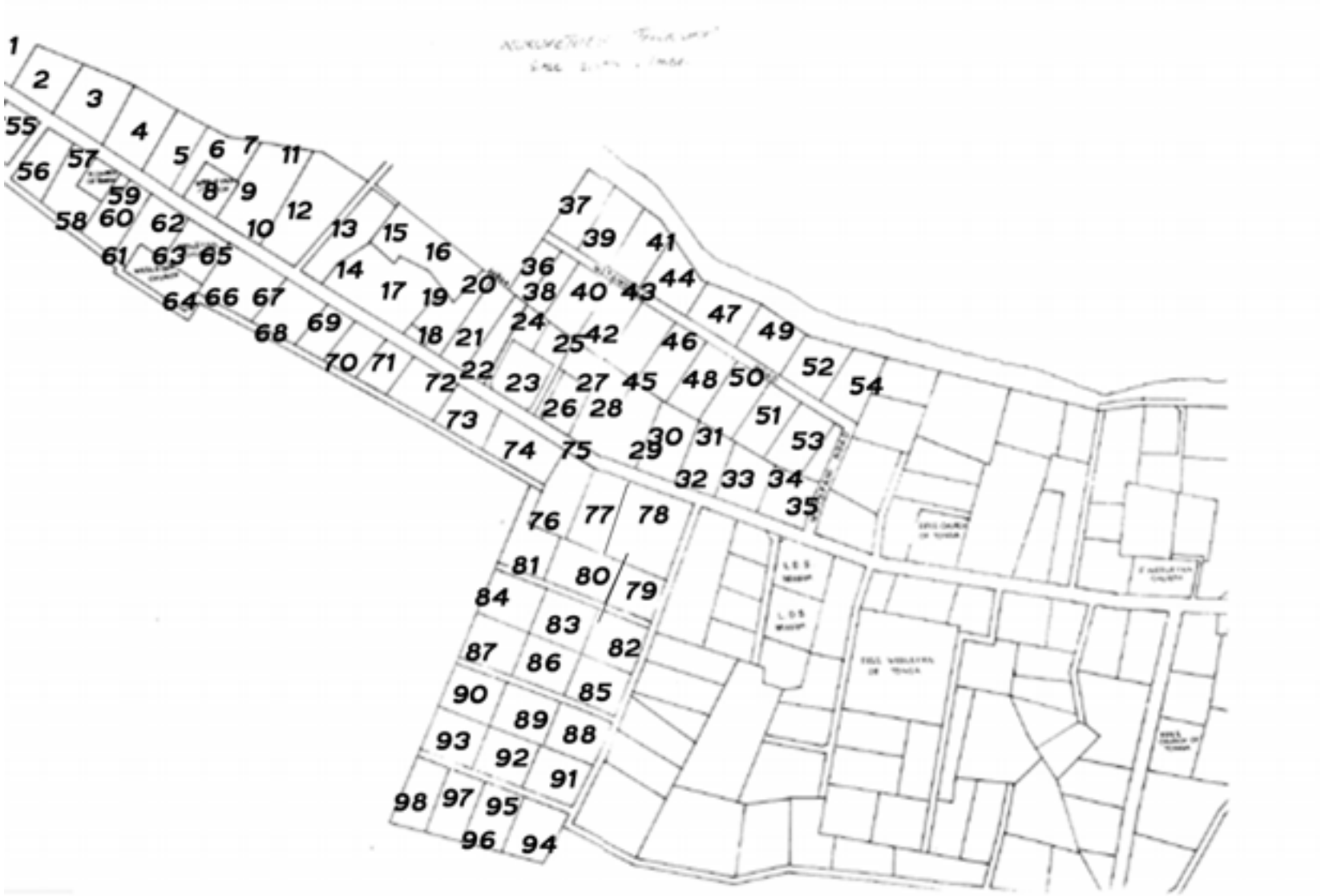
No.	Householder/Land Owner	√-No household V- vacant land?	Group No.
1.	Vili Longokava		
2.	Finehika Lavalu		
3.	Teu Mataele		
4.	Norman Kamoto	√	
5.	Sefita Tonga	√	
6.	Vai Tu'unukuafe		
7.	'Eniketi Tu'itavake		
8.	Penisoni Pau'uvale		
9.	Fe'iloaki Finau		
10.	Lenisiloti Lilo		
11.		V	
12.	Sioape Tu'iono		
13.	Lesieli Manulevu		
14.	Valeti Tu'alau		
15.	Pita Ngahe		
16.	Viliami Funaki		
17.	Lisiate Tu'alau		
18.	Ane Talasinga		
19.	Rev. Siaosi Moimoi		
20.	Sione Ika		
21.	Siosifa Ika		
22.	Peni Leha		
23.	Paini Afu	√	
24.	Ma'u Kakala Afu		
25.		V	
26.		V	
27.		V	
28.	Leimoti 'Ofa		
29.	Talaivosa Silinu'u		
30.		V	
31.	Sione Niu Muimuiheata		
32.	Uame Toluta'u		
33.	Uinitoni 'Ofa		
34.	Sione 'Ofa		
35.	Waltz Fakahau		
36.	'Amanaki Ika		
37.	'Ana Ika		
38.	Kapeli Ika		
39.	Kilifi Lavalu		
40.	Sefita Tonga		
41.	Tevita Veaniua		
42.	Sione Lavalu		
43.	Manase Lavalu		
44.		V	
45.	Sitaleki Tu'itavake		
46.	Viliami Tu'uefiafi	√	
47.	Losaline Lavalu		
48.	Taniela Tu'uefiafi		
49.		V	
50.	Hamala Mo'unga		

No.	Householder/Land Owner	√-No household V- vacant land?	Group No.
51.		V	
52.	Tamiano Pahulu		
53.	Muli Lua		
54.	Tevita Tu'ipulotu		
55.	'Alamoti Tonga		
56.	Moli Mo'unga		
57.	Sila Longokava		
58.	Free Church of Tonga Hall	√	
59.	Free Church of Tonga Chapel	√	
60.	Hulu Tukuafu		
61.	Sione Matafahi		
62.	Sepeti Tu'uefiafi	√	
63.	'Alafoki Lilo		
64.	'Ahokava Lavalu		
65.	FWC Chapel	√	
66.	FWC Hall	√	
67.	Vaha Lavalu		
68.	Community Hall & Tennis Court	√	
69.	Finau Matafahi		
70.		V	
71.	Latai Kinikini		
72.	Tevita Loti Ika		
73.		V	
74.	Lemiuela Vea		
75.	Taniela Hala	√	
76.	Ha'amonga Hala		
77.			
78.	Filimone 'Aho		
79.		V	
80.		V	
81.		V	
82.	Sione Mafi		
83.	'Ofa Hinemoa		
84.		V	
85.	Sione Mateaki		
86.		V	
87.		V	
88.	Kalesita 'Uluakiola		
89.	Hoseki Fotu		
90.	'Ana Haisila Olevao		
91.		V	
92.	'Amanaki Fakahau		
93.	Siueli Lavalu		
94.	'Oini Mo'ungahelangi		
95.	Leonaitasi Kavakava		
96.	Inu-e-hahau Fa'aui		
97.	Sione Fakahau		
98.	Siope Matafahi	√	

Total number of allotments = 98

Number with no household or vacant = 29

Number to be surveyed = 69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Annex 3: Questionnaire

Part 1: Household Survey

Survey Group….

Household Number…

Note 1: Household was defined as a group of people living together in the same 'api' and having evening meal together

A. The Household

1. Name of head of household…….

2. Male or Female (M/F)

3. Type of Household (circle the right description)

Nuclear family…….01

Parents or a parent with no childres……....02

Extended family (with aunty or sister family etc.)…..….03

Others (please explain)……..…04

4. Number of people in the household (write the right number only)…

5. Where was the household in the last five years (circle the right answer)

Tongatapu (apart from Nukuhetulu)……01

In Nukuhetulu……..02

'Eua……..03

Ha'apai…….04

Vava'u……..05

Niuas…….06

Other places (explain)……..……07

6. How long has the household been in Nukuhetulu (circle the right answer)

0-5 years…….…….……..01

6-10 years……..…02

11-15 years……..…..03

16 years or more…….…….…..04

B. Level of Education and Employment

Note 2: Not employed now but looking for employment……. 01

Still in school…….02

Household work……03

Retired/Pension…….04

Elderly……...05

Others (explain)…….06

Note 3: Self Employed

Farmer……..subsistence …….. 07

……..commercial……..... 08

Fisher……subsistence…….….. 09

……..commercial…….…….. 10

Farmer (pigs, cattle etc,)……

subsistence……...11

commercial……..12

Carving……13

Others (explain)……..14

7. Fill in the following Table using Notes 2 and 3 above

Name (all members of the Household	Age	Male/Female	Level of education (fill only with the numbers in Note 2	Employment (fill only with numbers in Note 3)

8. Fill in the following Table (only those who are still at school i.e.Note 2 (02))

.Name (of all those still at school)	Age	Male/Female	Grade and name of school

C. Level of Income

9. Circle the average household income per week (T$)

< $50 per wk……01

$50- $100/wk……...02

$100-$300/wk……..…03

$300-$600/wk……..…04

> $600/wk……....05

Other sources of income (estimation/year?)…...06

D. Household assets (vehicles and fishing boats only)

10. Circle the assets of the households

no vehicle…….….01

a fishing boat……02

no fishing boat…….……03

one vehicle……04

two vehicles……..05

three or more vehicles……...06

11. Circle the type of household residence building

Tongan fale…….…..01

Wooden fale…….…02

Concrete…….…..03

Wooden and Concrete…….04

Iron Tin……05

Cardboard……..…06

Others (explain)……07

E. Sources of Energy

12. For Lighting

Circle the right answer as it applies to you lighting in your household

Electricity (diesel)…….…...01

Kerosene…….……..02

Others (explain)……03

13. For cooking

Circle the right answer as it applies to the sources of energy your household use for cooking

Electricity (diesel)…….…….….01

Kerosene…….……02

Gas…….….03

Biomass……..04

Others (explain)……..05

F. Sources of Freshwater

14. Circle the right answer according to your household's resource of fresh water.

Piped water from the village source……..….01

Own water tank……..……02

Piped water from village source and own water tank……03

Own well……04

Others (explain)……..05

G. Access to Land and Land Title

15. Circle only the right answer

Town allotment is registered in a member of the household (Yes/No)

If no, what's the land arrangement? (informal from a relative or friends/lease)

Bush allotment is registered in a member of the household (Yes/No)

If no, what's the land arrangement? (informal from a relative or friends/lease)

No access to bush allotment……01

H. Churches

16. Which denomination most members of the household belong to?

I. Village Committee

17. Village committee that any member of the household is a member (fill in the table)

Name of Household member (M/F)	Name of Village Committee

J. Household Health

18. Common health problems of the household members (fill in the table)

Name of Household member (M/F)	Age	Name of Diease

K. Views on Waste Management

19. How important is waste management to you and your household? (circle only one)

Very important…….01

Important……..02

A little importance……03

Not importance…….04

L. What are your priority environmental issues that you would like IWP to address before the end of the project in 2006?

M. Any Observations by the interviewer

Part 2: Waste Characterization Study

Different Types of human induced waste

1). Circle the type of latrines in your household:

Flushed/septic	01 (go to [1a], [1e], and [1f] below)
Water pour pit latrine	02 (go to [1a] and [1e] below)
Pit latrine	03 (go to [1a] and [1e] below)
Any other (write here)	04

[1a]. Approximate size of the septic (length, width, and depth)

[1e]. How old is the septic?

(circle the correct answer) Not yet full/full (write down the number of times)

[1f]. Does the septic sealed or drained ?	yes/no (circle the correct answer)

2). Circle the type of water drainage from you bathroom:

Septic drainage	01 (go to [2a], [2e] and [2f] below)
No septic (onto the ground)	02 (go to [2a] and [2e] below)
Any other	03

[2a]. Approximate size of the septic (length, width, and depth)

[2e]. How old is the septic?

(circle the correct answer) Not yet full/full (write down the number of times)

[2f]. Does the septic sealed of drained?	yes/no (circle the correct answer)

3). Circle the type of water drainage from your washing:

Septic drainage	01 (tali ‘a e [3a], [3e] moe [3f] ‘i lalo)
No septic	02 (tali ‘a e [3a] moe [3e] ‘i lalo)
Any other	03

[3a]. Approximate size of the septic (length, width, and depth).

[3e]. How old is the septic?

(circle the correct answer) not yet full/full (how many times)

[3f]. Does the septic sealed or drained? yes/no (circle the correct answer)

4). Circle the type of water drainage from the kitchen

Septic drainage 01 (go to [4a], [4e] and [4f] below)

No septic 02 (go to [4a] and [4e] below)

Any other 03

[4a]. Approximate the size of the septic (length, width and depth)

[4e]. How old is the septic or hole?

(circle the correct answer) Not yet full/full (number of times)

[4f]. Does the septic sealed or drained? yes/no (circle the correct answer)

E. Waste from Animals

1). Fill in the table below with the mark (√) in relation to the number of animals you keep at home/how you keep them/and where you keep them.

Animal	*Number*		**How you keep them**				**Where**		
	large	**Small**	**Tie**	**Fenced**	**roam**	**Any other**	**town**	**push**	**others**
01. Pigs									
02. Dogs									
03. Horse									
04. Cow									
05. Goat									
06. Chicken									
07. Duck									
08. Cat									
09. others									

2).Do you reuse any of the animal waste for other activities?

(circle the correct answer) yes/no

(if yes, go to 2a and 2e below)

2a). What animal waste is that? (write down the number from table above.

2e). What kind of product/activity you used the animal waste for?

F. Agricultural chemical/pesticides

1). Do you use agricultural chemical or pesticides for your plantation? yes/no

(if yea, please fill in table 1a). below)

1a). Write down the type of plantation that used chemical or pesticides, time of the year or season that you used chemical

(Agricultural) Plant	**Chemical used**	**How long you have used?**	**Time/month used**
01.			
02			
03.			
04.			
05.			

2). How you access agricultural chemical?

Purchase from the shop	01
Get from a friend	02
Send from overseas by family or friends	03
Any other	04

3). How do you use the chemical?

Follow instruction from MAF	01
Follow instruction came with the chemical	02
Use my experience and advice from other farmers	03
Any other	04

4). How do you keep/dispose left over chemical?

Sealed it and leave in the push	01
Sealed and left in the household	02
Throw to the rubbish heap	03
Any other	04

H. Disposal of household waste

1). Fill in the table below with the mark (√) in relation to ways of disposing household waste.

Types of waste	**Ways of disposal**						
	Burn	**Bury**	**Reuse** (write below: compost/feed animals, etc)	**Throw to the:**			
				rubbish heap	***push***	***mangroves***	***sea***
01. batteries							
02. medicines (mixture)							
03. medicines (tablets.)							
04. paint							
05. agricultural chemical							
06. fuel/petrol							
07. alminium/tin cans							
08. glass bottle							
09. iron/copper							
10. spray cans (mortein)							
11. scrape food							
12. food peelings							
13. paper							
14. wood/leaves							
16. rubber/leather							
17. plastic/diaper							
18. hard plastics							
19.							
20.							